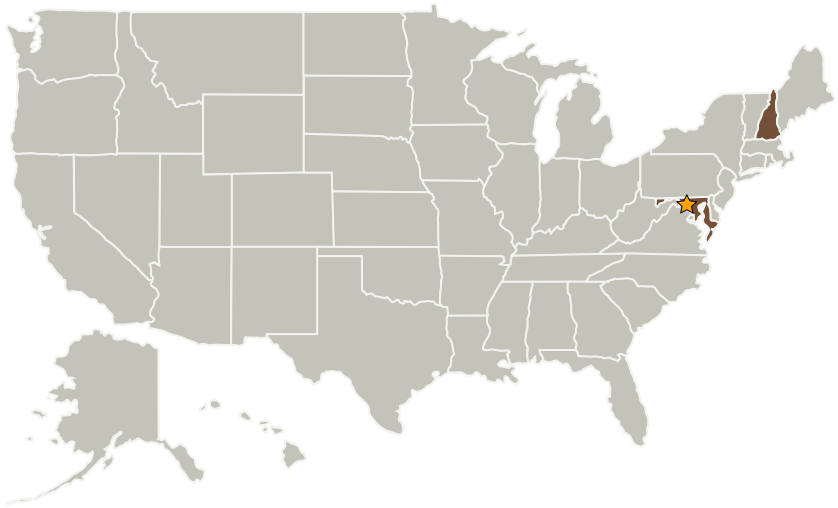
An Advanced Cooling System for In-Situ Resource Utilization, Phase II

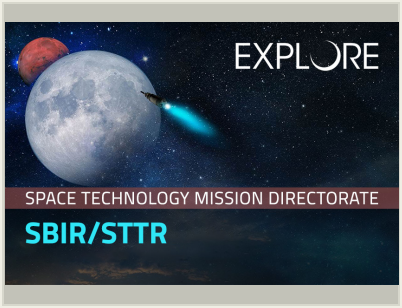
Completed Technology Project (2009 - 2012)

Project Introduction

NASA plans to produce cryogenic oxygen and hydrogen to power regenerative fuel cells for lunar surface exploration. The oxygen and hydrogen will be produced by electrolysis of water from In Situ Resource Utilization (ISRU) reactors. The electrolysis products will be warm high-pressure gases, requiring significant cryocooler power to achieve the desired storage conditions. This power can be reduced by expanding the gases adiabatically from the electrolysis pressure to storage pressure. We propose to develop innovative turboalternators to maximize this effect and convert the extracted fluid power into useful electric power. Small flow rates and high fluid densities require turbine rotors that are extremely small and operate at high speeds. Cryogenic gas bearings and miniature rotor fabrication techniques are key features that create high efficiency in our approach. The gas bearings also enable reliable, long-life, maintenance-free operation. The proposed development will leverage decades of Creare experience with cryogenic gas-bearing turbomachines. In Phase I, we developed optimized turboalternator designs by conducting trade studies, specifying design details, analyzing performance, and demonstrating bearing operation with two-phase rotor flow. During Phase II, we will create a complete set of fabrication drawings, develop critical fabrication processes, fabricate a prototype turboalternator, and measure its performance at representative operating conditions.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Creare LLC	Supporting Organization	Industry	Hanover, New Hampshire

Primary U.S. Work Locations	
Maryland	New Hampshire

Project Transitions

December 2009: Project Start

December 2012: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.3 Power Management and Distribution
    - TX03.3.3 Electrical Power Conversion and Regulation